(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 053 897**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 81305597.7

(22) Date of filing: 26.11.81

(51) Int. Cl.³: D 21 H 5/00
//H01B3/52

(30) Priority: 05.12.80 GB 8039121

(43) Date of publication of application:
16.06.82 Bulletin 82/24

(84) Designated Contracting States:
AT BE DE FR GB IT NL SE

(71) Applicant: T&N Materials Research Limited
20 St. Mary's Parsonage
Manchester M3 2NL(GB)

(72) Inventor: Lancaster, Robert Allan
64 Whitegate
Littleborough Lancs(GB)

(72) Inventor: McKenzie, Noel Christopher
208 Daventry Road Kirkholt
Rochdale Lancs(GB)

(72) Inventor: Hargreaves, Brian
19 Aldermere Cresent
Flixton Manchester M31 2UE(GB)

(74) Representative: Newman, Dennis Daniel Ernest et al,
20, St. Mary's Parsonage
Manchester, M3 2NL.(GB)

(54) **Flexible starch bound non-asbestos paper.**

(57) Non-asbestos alternatives to starch-bound asbestos papers comprise a matrix of unfired ball clay which is reinforced by fine particles of a non-fibrous charged-layer-silicate mineral such as mica and by organic web-forming fibres such as cellulose, the whole being bound together by hydrolysed starch.

EP 0 053 897 A1

Flexible starch-bound non-asbestos paper

This invention relates to starch-bound paper, and provides non-asbestos alternatives to starch-bound asbestos papers.

Starch-bound asbestos papers contain asbestos fibres as the predominant raw material, these fibres being bound together with small amounts of hydrolysed starch to provide the necessary strength and flexibility. Such papers find use for a variety of purposes, e.g. as high temperature flexible insulation in electrical equipment. They are commonly made in the form of flexible sheet of thickness 0.1-1.5 mm on conventional paper-making machines such as the Fourdrinier. In the process, an aqueous slurry of the ingredients which are to compose the product is progressively dewatered as a layer on a water-permeable conveyor (usually of wire mesh), the dewatered layer being subsequently compressed and dried.

According to the present invention, non-asbestos flexible sheet material of thickness 0.1-1.5 mm comprises a matrix of unfired ball clay which is reinforced by fine particles of a non-fibrous charged-layer-silicate mineral and by organic web-forming fibres, the whole being bound together by hydrolysed starch; said flexible sheet material being

made by de-watering on a water-permeable conveyor a layer of aqueous slurry of unfired ball clay, fine particles of said silicate mineral, organic web-forming fibres and hydrolysed starch, and compressing and drying the de-watered layer; said aqueous slurry containing, by weight of solids content,

ball clay	30 - 60 %
silicate mineral	25 - 55 %
organic web-forming fibres	3 - 15 %
hydrolysed starch	2 - 6 %

Our British Patent Application 2 031 043A published April 1980 discloses a non-asbestos product which comprises a matrix of unfired ball clay containing reinforcement and organic web-forming fibres and which contains hydrolysed starch as complementary binder. However, although that product is made on paper-making machinery, it is a board, i.e. inflexible compared to paper, and the function of the starch in it is to enable the board to be remoulded when wetted with water.

In the product of the present invention (referred to in the rest of the description as 'paper'), the ball clay provides a flexible cohesive matrix. Ball clay is a fine-grained, highly plastic, mainly kaolinitic sedimentary clay. (The terms 'kaolinitic' and 'kaolinite' are mineralogical ones, indicating chemical composition and chemical structure; they are not to be confused with the term 'kaolin', used to denote a highly refractory clay which approaches the mineral kaolinite in chemical composition and structure but which- by contrast with ball clay - is hardly plastic at all.) Various types of ball clay have varying proportions of

are used mainly in the manufacturing of pottery and refractories, in admixture with other clays (such as the kaolin mentioned earlier) to impart plasticity to them and to increase the green strength of the unfired ware.

The function of the organic web-forming fibres is primarily to enable the paper to be formed on conventional paper-making machinery, but additionally those fibres impart strength to the ball clay matrix of the finished paper, just as the non-fibrous charged-layer-silicate mineral (the primary reinforcement) does. The organic web-forming fibres are preferably cellulose fibres, but may alternatively be polyethylene or polypropylene fibres of the kind commercially available under the name PULPEX. In the preparation of the aqueous slurry to be dewatered, the web-forming fibres are employed at a freeness of 60-90° Schopper-Riegler.

The reinforcing fine particles of non-fibrous charged-layer-silicate mineral consist of particles capable of passing a sieve of aperture 250 μm. Preferably at least 75% by weight of the particulate non-fibrous charged-layer-silicate mineral present should meet this specification.

The non-fibrous charged-layer-silicate mineral employed may be a mica or a chlorite. The chlorites have structures containing infinite two-dimensional ions of opposite electrical charge, the negatively charged layers having compositions ranging from $[Mg_3(AlSi_3O_{10})(OH)_2]^-$ to $[Mg_2Al(Al_2Si_2O_{10})(OH_2)]^-$, the positively charged layers having the composition $[Mg_2Al(OH)_6]^+$. Such non-fibrous charged-layer-silicate minerals are to be distinguished from non-fibrous layer sillicate minerals such as kaolinite, talc and pyrophyllite, where

the infinite 2- dimensional layers (e.g. $Al_2(OH)_4Si_2O_5$ in kaolinite) are uncharged.

The hydrolysed starch is preferably a farina starch. The paper may also contain a small proportion, suitably in the range of 1-10%, of rayon fibres, to impart green strength to the sheet material between the dewatering and drying operations, and also to impart additional strength to the finished paper.

The density of the paper will ordinarily be in the range 700-1100 kg/m^3, its tensile strength at least 3 MPa and its burst strength at least 40 KPa.

The papers of the invention may be impregnated with other materials, such as resins, to give special properties for particular purposes. They may have surface coatings e.g. of shellac varnish or synthetic resin applied to them. They may also be given a backing e.g. of manilla paper, to increase mechanical strength, especially tensile strength, when that is required in the wrapping of conductors and the like, and they may be incorporated in double or multiple layer constructions with glass threads between adjacent paper layers to give particularly high strength, as when wrapping cables.

The invention is further illustrated by the following Example.

EXAMPLE

A. Preparation of Stock

(i) Lapponia pulp (bleached softwood sulphate pulp) in sheet form was made into an aqueous slurry of solids conent about 3% by weight and

treated in a disc refiner until its freeness value was 90° Schopper Riegler.

(ii) The pulp of (i) (500g. dry weight = 16.7kg wet weight) was added to 90 litres of water in a mixing tank, and the diluted pulp was agitated vigorously for 1 minute. There were then added, with vigorous stirring: non-fibrous charged-layer-silicate mineral (mica or chlorite), at least 75% by weight of which passes through a sieve of aperture 250 μm; ball clay (90% passing a sieve of aperture 5 μm); rayon fibre (3 denier; chopped to 3-8mm fibre length); farina starch (5% aqueous solution, prepared by heating at 100°C for 5-10 minutes);

in proportions such that the solids content of the resulting slurry was made up of 46% non-fibrous charged-layer- silicate mineral, 5% cellulose fibres, 40% unfired ball clay, 5% rayon fibres and 4% hydrolysed starch.

(iii) The slurry of (ii) was diluted to 1-3% solids content.

B. Preparation of Paper

The stock (slurry) of A above was made into flexible sheet material in an entirely conventional way on a Fourdrinier flat wire paper machine, such as is described in chapters 10 and 11 of "Paper and Board Manufacture" by Julius Grant, James H. Young, and Barry G. Watson (Publishers: Technical Division, the British Paper and Board Industry Federation, London, 1978). The slurry is progressively dewatered as it travels on the water-permeable conveyor of the

machine, and the dewatered material is consolidated by pressing between rollers, and then dried to low moisture content (suitably 2% by weight). The properties of the paper thus obtained were:-

Thickness	0.25 mm	
Density	940	kg/m^3
Mass per unit area ('substance')	235	g/m^2
Tensile strength		
in machine direction	4.61	MPa
across machine	3.55	MPa
Burst strength	73.4	KPa
Ignition Loss	18.1	%
Flexibility Test	passed	

To pass the flexibility test referred to, a specimen of paper (50mm x 230 mm, with the 230mm side parallel to the grain) should show no evidence of breaking when bent through 180°C around a mandrel of 50mm diamter, with use of just enough force to keep [illegible] in contact with the mandrel

CLAIMS:-

1. Non-asbestos flexible sheet material of thickness 0.1-1.5mm comprising a matrix of unfired ball clay which is reinforced by fine particles of a non-fibrous charged-layer-silicate mineral and by organic web-forming fibrers, the whole being bound together by hydrolysed starch; said flexible sheet material being made by dewatering on a water-permeable conveyor a layer of aqueous slurry of unfired ball clay, fine particles of said silicate mineral, organic web-forming fibers and hydrolysed starch, and compressing and drying the dewatered layer; said aqueous slurry containing, by weight of solids content,

ball clay	30-60%
silicate mineral	25-55%
organic web-forming fibers	3-15%
hydrolysed starch	2-6%

2. Flexible sheet material according to claim 1, in which the organic web-forming fibres are cellulose fibres.

3. Flexible sheet material according to claim 1 or 2, made from a slurry which includes rayon fibres as additional reinforcement for the sheet material.

4. Flexible sheet material according to claim 3, in which the content of rayon fibres in the slurry is 1 to 10.% by weight of slurry solids.

5. Flexible sheet material according to any preceding claim, in which the organic web-forming fibres present in the slurry have a freeness of 60-90°

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EUROPEAN SEARCH REPORT

Application number EP 81 30 5597

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
Y	WO - A - 80/01576 (HOLLINGWORTH & VOSE) * Entire document * --	1-3
PY	EP - A - 0 027 705 (TURNER & NEWALL) * Entire document * --	1-5
DY	GB - A - 2 031 043 (TURNER & NEWALL) * Entire document * ----	1,2

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

D 21 H 5/00//
H 01 B 3/52

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

C 04 B
D 21 H

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same category
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	05-03-1982	NESTBY